Stochastic Weather Generator Based Ensemble Streamflow Forecasting

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Abstract. Efficient water resources management owes considerably to skillful basin wide streamflow forecasts at various time scales; the skillful projection of the streamflow probability density function (PDF) is especially of interest. Currently, forecasting centers such as the Colorado Basin River Forecasting Center (CBRFC) implement methods based on observed data, such as Ensemble Streamflow Prediction (ESP). ESP is created from historical daily weather sequences and a physically based watershed model. However, the number of ensembles is restricted to the number of years of historical data. Presently, the CBRFC maintains a 30 year calibration period. Furthermore, if seasonal forecast information is included through a use of a subset of these years, the ensemble size decreases substantially, further degrading the resolution of the estimated PDF. To improve on this, we propose a stochastic weather generator based approach coupled to the hydrologic modeling system. The weather generator uses a Markov Chain to simulate the precipitation state of a day (wet or dry) and a K-nearest neighbor (K-NN) resampling approach to simulate the daily weather vector. This weather generator can also produce daily weather sequences conditioned on seasonal categorical climate forecasts. However, k-NN resampling can only be performed on a single time series, which proves troublesome for multisite generation. A K-means clustering analysis was implemented to organize available weather time series into correlated groupings. Each cluster was combined by an elevation-weighted average to produce a synthetic time series for the k-NN weather generator. From this, daily weather sequences can be produced on a basin-wide scale and can then be driven through the hydrologic model to produce an ensemble forecast of streamflow. The San Juan River Basin was chosen for testing as it contains complex terrain and ENSO climate signals. Preliminary results will demonstrate the weather generator's ability to capture historic variability across multiple locations in the basin. Results will also include the pairing of the weather generator with CBRFC's new Community Hydrologic Prediction System (CHPS).

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